

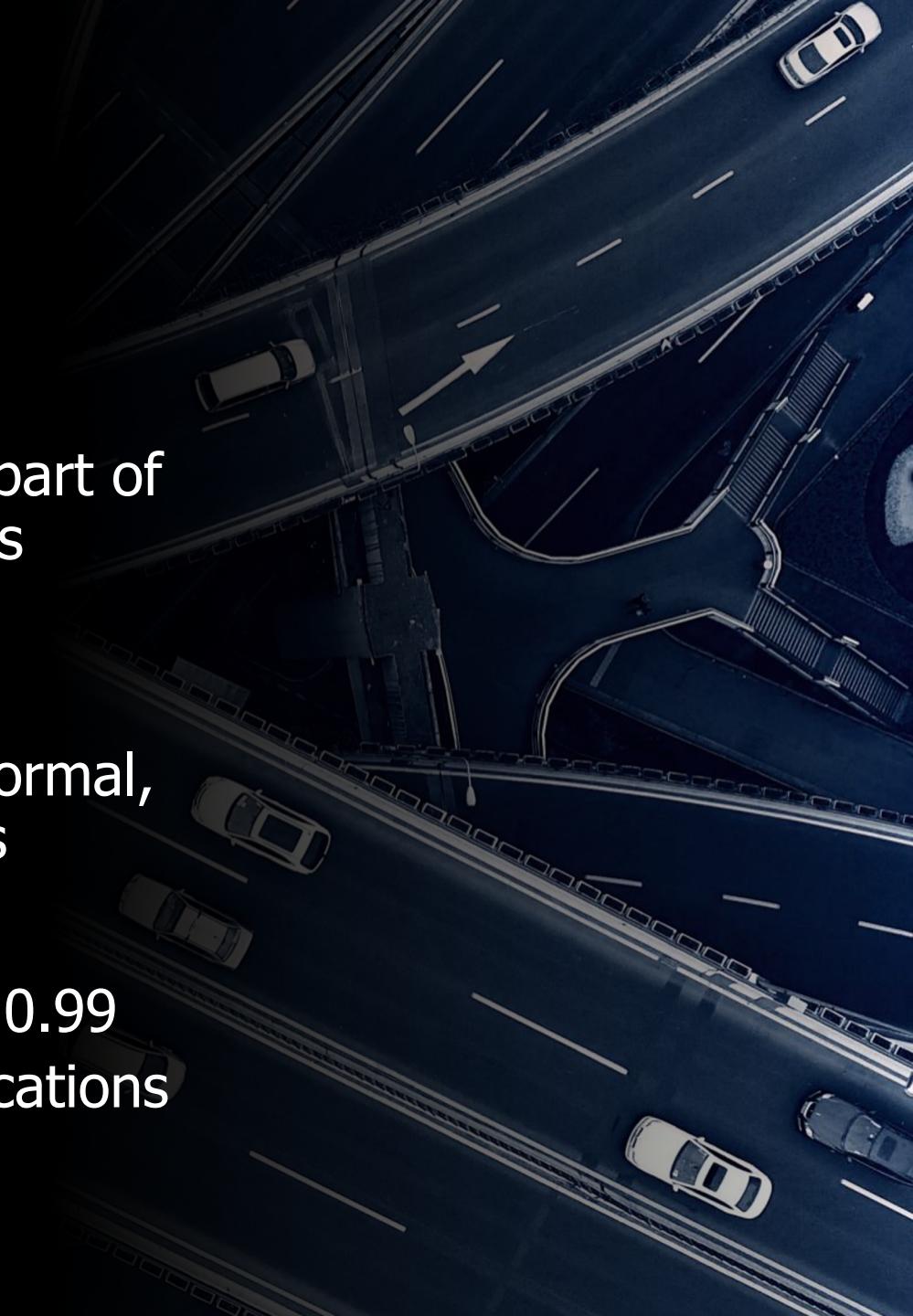
Classification of Abnormal Driving Behaviors



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Overview

- Motivation
 - Analysis of driver behavior is an important part of the function and safety of semi-autonomous vehicles
- Objectives
 - Classify driving behaviors as normal or abnormal, and warn drivers about abnormal behaviors
- Results
 - Random Forest model achieves F2-score > 0.99
 - Interactive widget to explore model classifications



Data & Methods

- UAH-DriveSet
- Data collected from smartphone inertial sensors (accelerometer and gyroscope) and GPS
- Drivers are **asked** to simulate “normal” or “abnormal” (aggressive or drowsy) driving
 - Participant/response bias



Data & Methods

- UAH-DriveSet
- Weather Underground

BeautifulSoup



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- Scikit-learn classification models
 - KNN, logit, decision tree, Random Forest



- Choose F2-score as relevant evaluation metric

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- IPywidgets
 - Interactive application of model to new driving behaviors



Results

- Model must:
 - Handle non-linear decision boundaries
 - Have high performance, without overfitting
 - Make fast, real-time classifications

⇒ Select Random Forest classifier ($F_2 = 0.9925$)



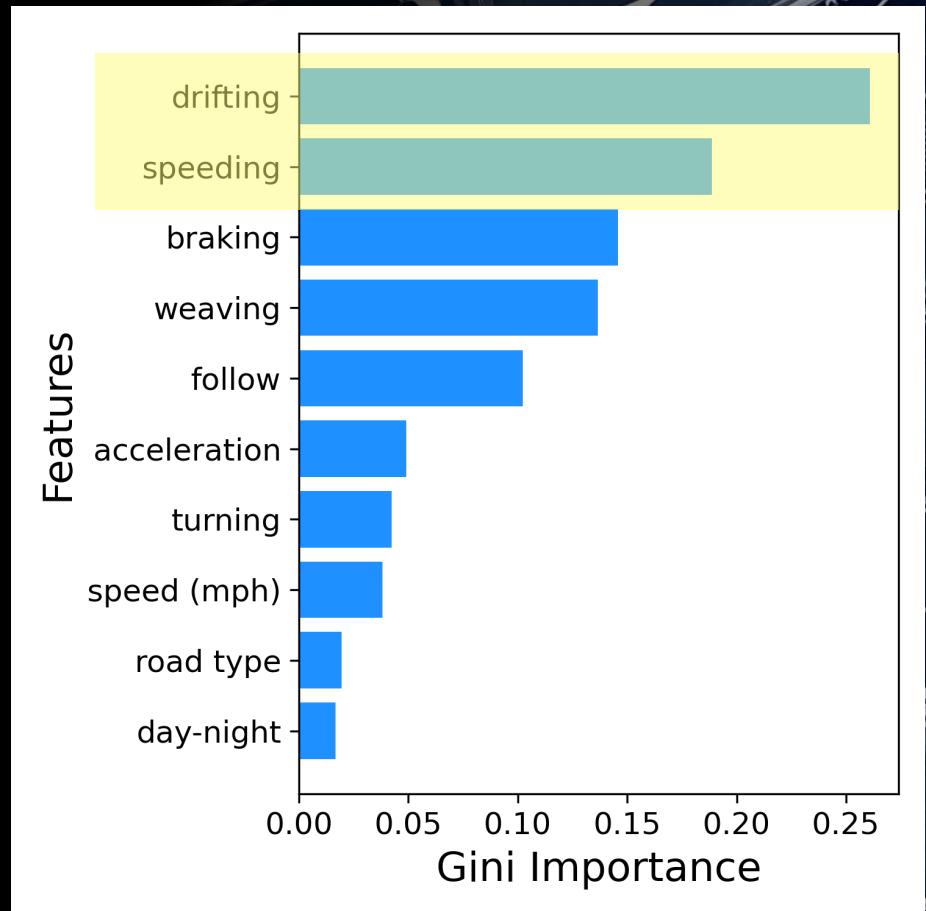
Results

- Model has been tuned, but...
- Very high F2-score may (in part) be due to experimental design flaw
 - Participant/response bias
- Asked to drive “normally”, driving behaviors are likely safer *because* they are being observed
- Classes are easily separated by the model



Results

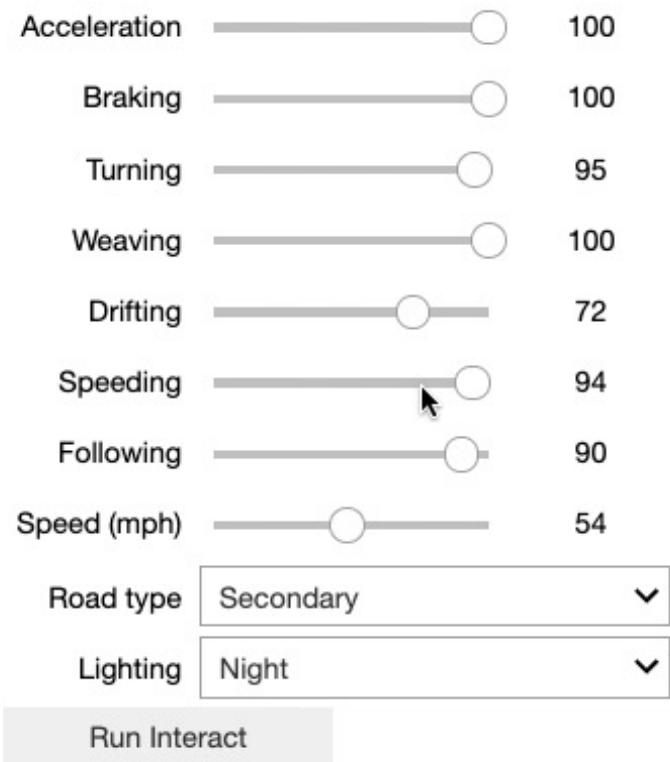
- Drifting (within lane) and speeding are the most important features
- Intuitively, drifting occurs while drowsy-driving and speeding occurs while aggressively-driving



Discussion

- Interactive widget allows us to explore parameter-space between the two distinct classes in the data set
- “Simulated” driver *starting* to fall asleep at the wheel, determine at what point that system would warn the driver

To interact, go to
tinyurl.com/rfinteract



Future Work

- Data with more real-life observations of driving behaviors (user data from e.g., Waze)
- Tune XGBoost model
- Streamlit App with IPywidget



Questions?



To interact, go to
tinyurl.com/rfinteract

Acceleration 100

Braking 100

Turning 95

Weaving 100

Drifting 72

Speeding 94

Following 90

Speed (mph) 54

Road type

Lighting

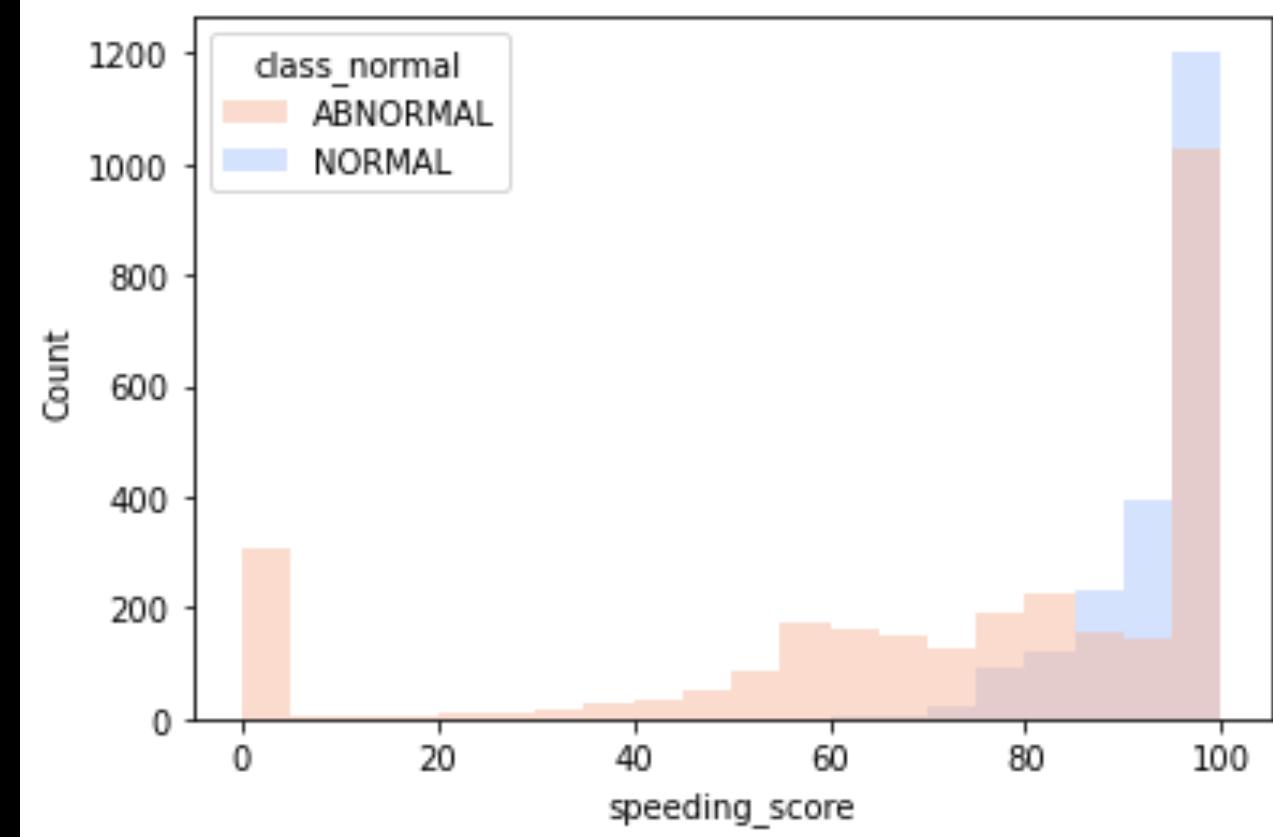
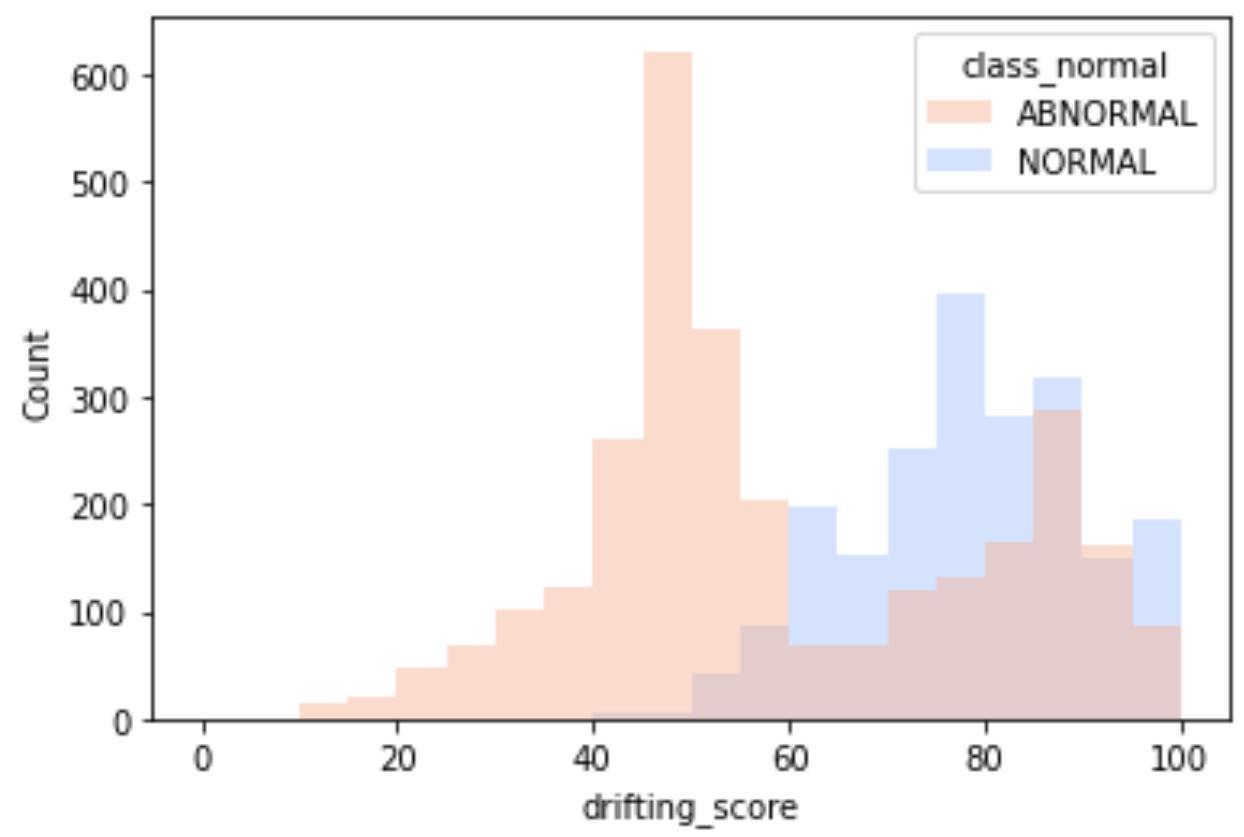
Run Interact

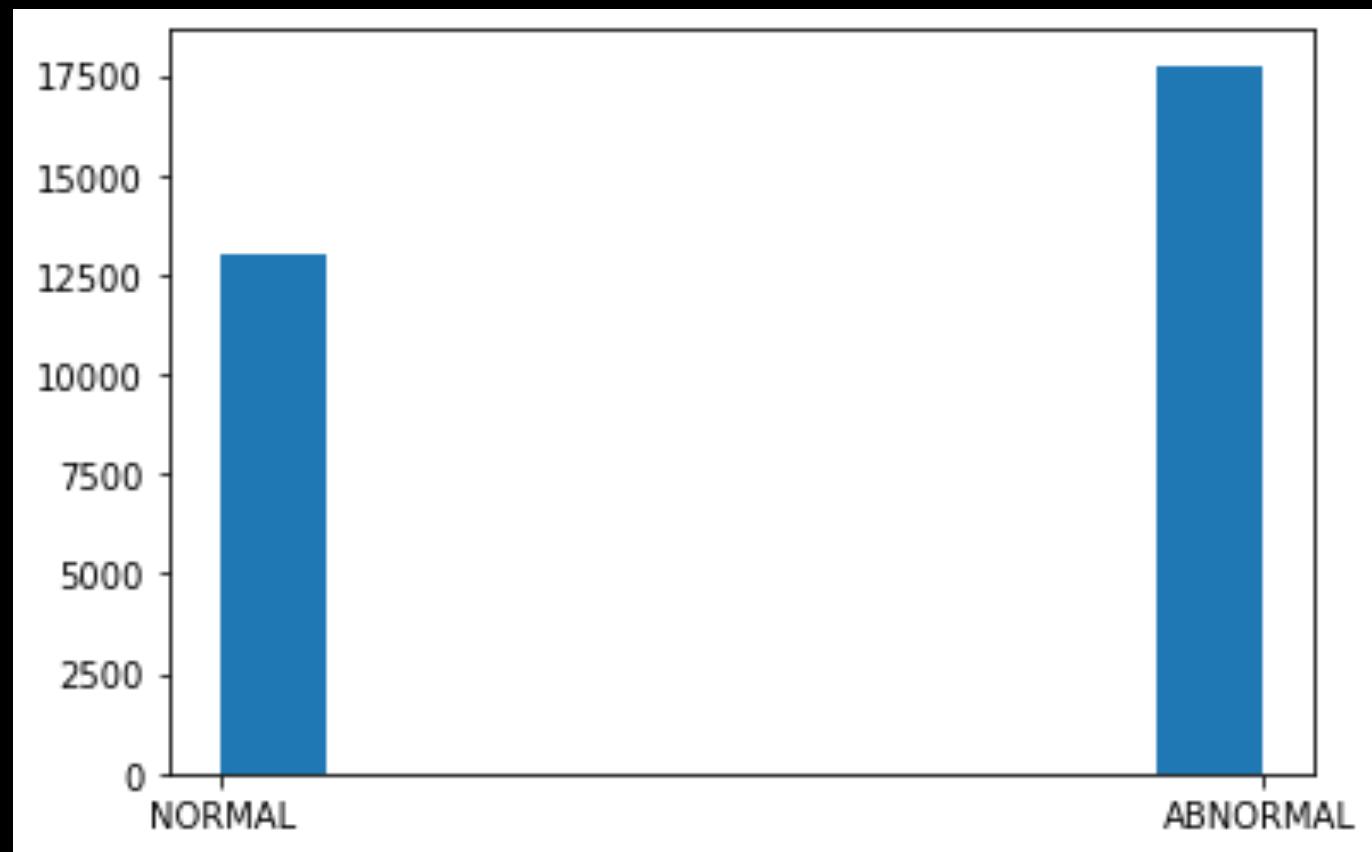
Predicted: Normal driving
(Probability: 0.04)

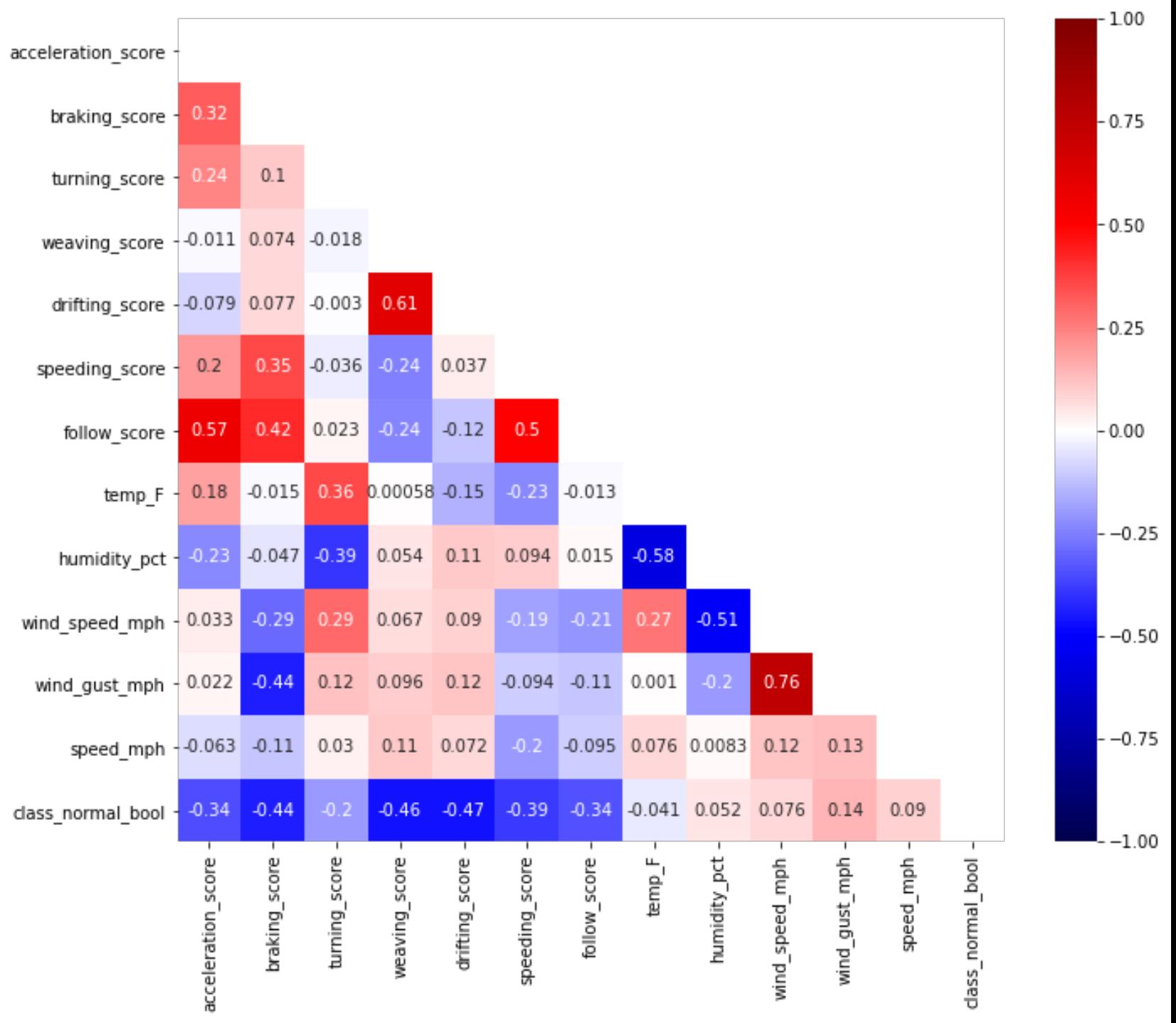


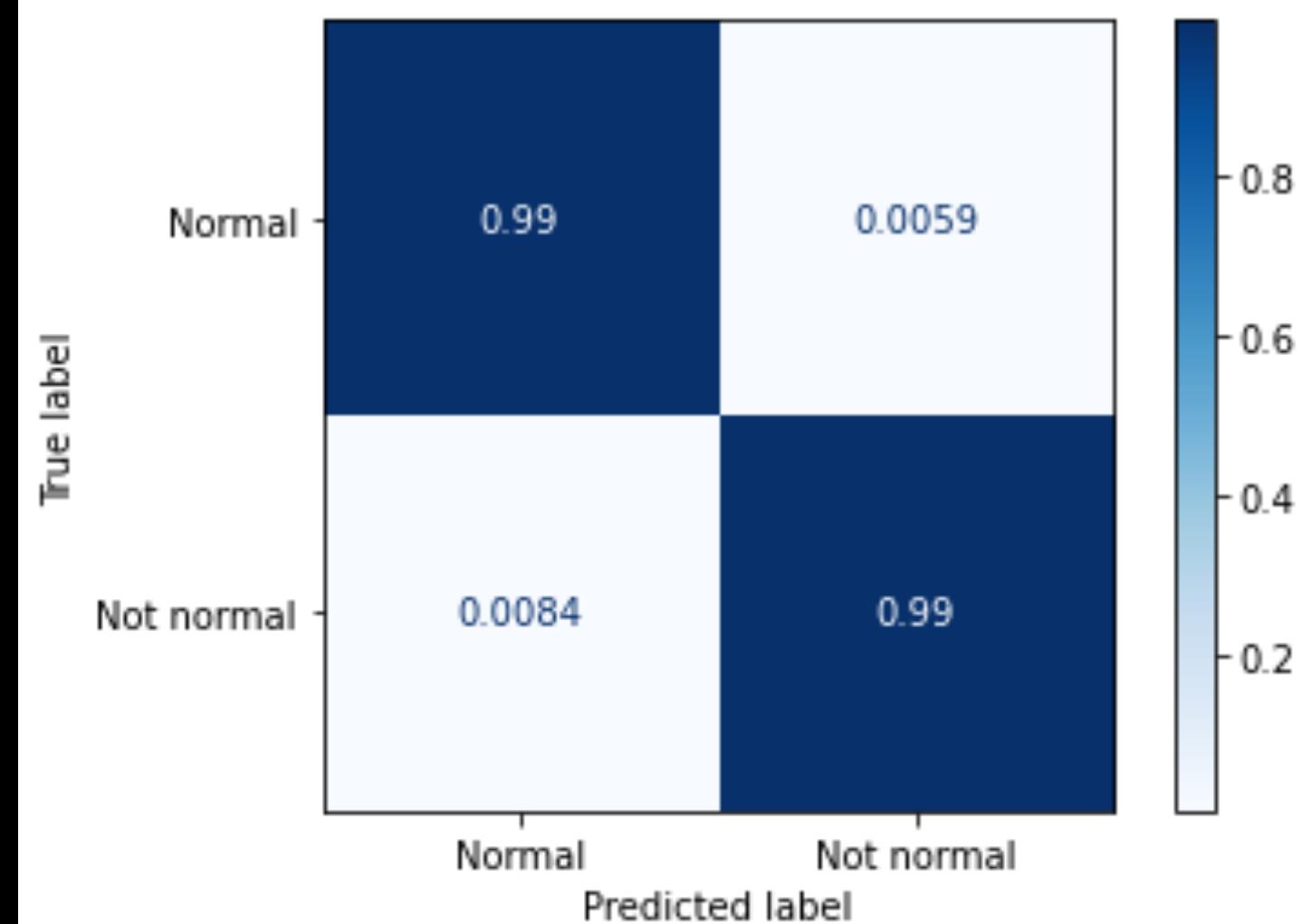
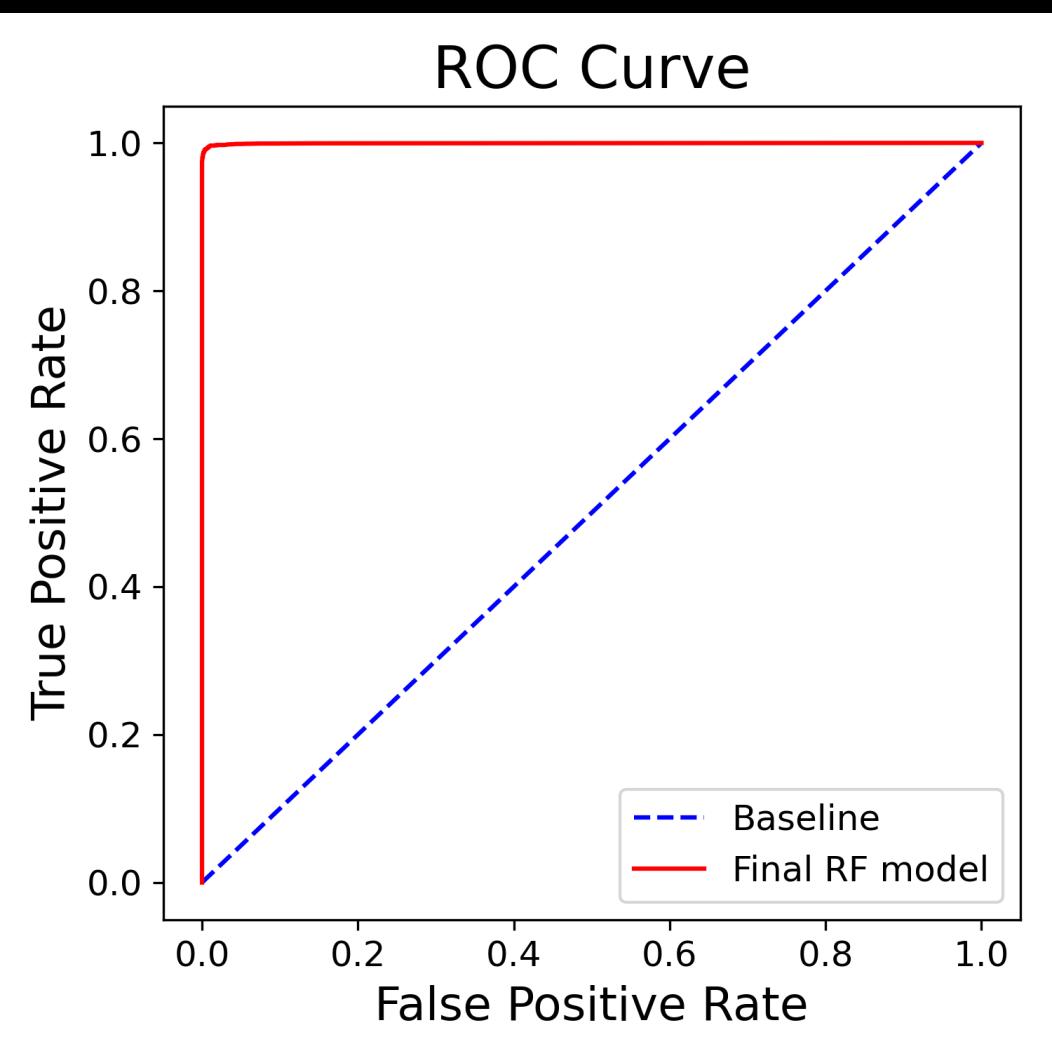
Appendix











ROC Curves

